

GEVORGIAN, S. et al.
Serial No. 10/781,930

Atty Dkt: 4127-13
Art Unit: 2817

AMENDMENTS TO THE SPECIFICATION:

Please amend the paragraph beginning at page 3, line 1, as follows:

Substrates comprising ferroelectric materials in resonators and filters are of interest for different reasons. Among other things ferroelectric materials are able to handle high peak power, they have a low switching time, and the dielectric constant of the substrate varies with an applied biasing voltage, which makes the impedance of the device vary with an applied biasing electric field. For example US-Patent 5 908 811, "High Tc Superconducting Ferroelectric Tunable Filters", shows an example of such a filter which should get low losses by means of using a single crystal ferroelectric material. A ferroelectric thin film substrate is used. However, this device as well as other resonators and filters based on ferroelectric materials suffer from the drawback of the quality factor (Q-value) of the ferroelectric substrate or element decreasing drastically with the applied voltage, when a biasing voltage is applied. This has recently been established by A. Tagantsev in "DC-Electric-Field-induced microwave loss in ferroelectrics and intrinsic limitation for the quality factor of a tunable component", Applied Physics Letters, Vol. 76, No. 9, February 28, 2000, p. 1182-84, to be a consequence of a fundamental loss mechanism (called quasi-Debye Effect) induced in the ferroelectric material by the applied biasing field. However, so far, no satisfactory solution to the problem associated with induced losses in tunable ferroelectric resonators has been found.

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Please amend the paragraph on page 11, line 17, as follows:

Parallel plate resonators, for example in the form of circular dielectric disks and circular patches on dielectric substrates, have found several different microwave applications. The resonators are seen as electrically thin if the thickness (d) is smaller than half the wavelength of the microwave (λ_g) in the resonator, $d < \lambda_g/2$, so that no standing waves will be present along the axis of the disk. Electrically tunable resonators based on circular ferroelectric disks have been largely investigated for applications in tunable filters. A simplified electrodynamic analysis of a parallel plate resonator proposes a simple formula for the resonant frequency:

$$f_{nm0} = \frac{c_0 k_{nm}}{2\pi r \sqrt{\epsilon}}$$

where $c_0 = 3 \times 10^8$ m/s is the velocity of light in vacuum, ϵ is the relative dielectric constant of the disk/substrate, r is the radius of the conducting plate, and k_{nm} are the roots of Bessel functions with mode indexes n and m . For an electrically thin parallel-plate resonator the third index is 0. The above formula may be corrected taking fringing fields into account.

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Please amend the paragraph beginning at page 12, line 14, as follows:

In a particularly advantageous implementation of the present invention, the mode selected for the resonators is the TM_{020} mode. The invention is however not limited to any particular mode but substantially any mode could be selected. Mode selection is among others discussed in "Microwave Device and Method Relating Thereto" with U.S. Application No. ~~09/539,797~~ Patent 6,501,972 as discussed earlier in the application.

Please amend the paragraph beginning at page 20, line 31, as follows:

The inventive concept is also applicable to dual mode operating resonators, oscillators, filters whereby dual mode operation can be provided for in different manners, e.g. as disclosed in the patent application "Tunable Microwave Devices" and US Patent ~~US Patent 6,463,308~~ which was incorporated herein by reference.

Please amend the paragraph beginning on page 21, line 14, and continuing to page 21, line 30, as follows:

In one implementation the inventive concept is extended to a tunable filter 100 (refer to Fig. 11). ~~It is supposed that~~ Two resonator apparatuses 10D, 10E are provided each comprising a first resonator 1D, 1E respectively and a second resonator 2D, 2E respectively, which share a common ground plane 13F. In this embodiment the first resonators 1D, 1E comprise a common substrate 11C. There may alternatively be separate substrates. The distance between the resonator apparatuses gives the coupling strength of the filter. The resonator apparatuses can comprise circular disk resonators as described in for example Figs. 4-8 or any other alternative kind of resonators, the main thing being that two resonator apparatuses as discussed herein are used to provide a tunable two-pole filter. Coupling between the resonators of each resonator apparatus is provided by coupling means 5D, 5E. By using tunable disk resonators, the power handling capability will be higher than if thin film resonators are used. The ~~in-~~put and output coupling means are not illustrated in this Fig.